analytical geometry. In fact, a considerable part of Apollonius's treatise is coordinate geometry pure and simple; but it is expressed throughout in a strictly geometrical form. This is not without its advantages, both theoretical and practical: it avoids the thorny question of the continuity of numerical quantity, and it compels the reader to realise the meaning of every step that is taken. It is not unlikely that a well-trained Greek mathematician could follow the geometrical demonstrations as easily as the modern analyst can assimilate the corresponding algebraical proofs; it is anything but easy for one who has been brought up on the system now current to familiarise himself with the methods and points of view which prevailed in the age of the Ptolemies.

Still the labour is well worth undertaking, and Mr. Heath's edition will do much to lighten it. It may be well to state at once that the book will not relieve the serious student of the duty of consulting the original text. The editor, after performing the laborious task of literally translating the whole treatise, decided, very wisely, we think, not to publish it in that form. Instead of this, he has recast it into a form similar to that employed in most text-books on geometrical conics; he has occasionally condensed several propositions into one, made some slight rearrangements of order, and omitted, or merely given an abstract of, a certain number of propositions which are either of slight importance, or indirect proofs of converses by the usual *reductio ad absurdum*.

The result is that the English reader has before him the substance of Apollonius's great work, in a notation with which he is himself familiar, while at the same time he may, with a slight effort, read it back into the geometrical form of the original. In this sense it deserves to be called an edition, and is not a mere caricature tricked out with modern "improvements." Apart from the notation, the book really gives a trustworthy presentation of the contents and method of the original; the amount of alteration which the actual text has undergone may be estimated by the literal transcripts of Book III. Prop. 54, and Book II. Prop. 50 (one case), which will be found on pp. lxxxix–xciv of the Introduction. Some may object that the condensation is excessive; but we are inclined to think that this is not the case, when we consider the object which the editor had in view, namely to provide an edition "so entirely remodelled by the aid of accepted modern notation as to be thoroughly readable by any competent mathematician."

In this praiseworthy aim Mr. Heath has certainly succeeded, and it may be hoped that the "Conics" will now attract the attention which it undoubtedly deserves. The more the treatise is examined, the more evident become its power and comprehensiveness. Apollonius begins by considering any plane section of a circular cone, not necessarily right, and at once obtains a result equivalent to the equations of the parabola, ellipse and hyperbola in the forms

$$y^2 = px, \quad y^2 = px \pm \frac{p}{d}x^2$$

referred to a diameter and the tangent at one end of it; p being the parameter, and d the corresponding diameter. It is to be observed that, in the first instance, Apollonius speaks of *the* diameter, namely the particular one associated with the axial triangle of the cone. He then goes on to prove the existence of a conjugate diameter, and shows that any chord through the centre is bisected there; then, after a discussion of tangents, comes a very remarkable section, in which the transition is made from the original diameter and the tangent at one end of it to any other diameter and corresponding tangent. Every one is more or less aware of the fact that Apollonius practically solved the problem of drawing normals to a conic from any point in its plane; it is perhaps hardly so well known that he was acquainted with many of the focal properties of central conics, with the auxiliary circle, and with the harmonic properties of poles and polars. Oddly enough, the focus-directrix property of a conic does not appear, and was apparently unknown to Apollonius; the directrix is never used or mentioned, and the foci of a central conic are obtained by a construction equivalent to $AS.SA^1 = CB^2$. For this reason, no doubt, the focus of a parabola is not used or mentioned. But, with this one exception, almost all the principal theorems of ordinary geometrical conics are to be found in this treatise, composed more than twenty-one centuries ago.

The text of Mr. Heath's edition is preceded by a very valuable introduction, in which will be found an excellent account of the earlier history of conic sections among the Greeks, followed by an instructive essay on the characteristics and methods of Apollonius. This, with the appendix on the terminology of Greek geometry, will be of great service to those who may feel attracted towards research in the history of mathematics; a subject not interesting to many, but fascinating to the few who combine the instinct of an antiquarian with the necessary linguistic knowledge and mathematical ability.

One or two suggestions may perhaps be made in anticipation of another edition. A glossary of Greek technical terms, or at any rate an index of them, with references to the pages of the introduction where they are explained, would be a useful addition. The figures, on the whole, are clear, but some of them might be more accurately drawn; and in some of the longer and more difficult propositions it is very inconvenient to have to turn back to look at a figure on a previous page.

G. B. M.

THE HARE, FROM THE FIELD TO THE TABLE.

Fur and Feather Series.—The Hare. Edited by A. E. T. Watson. 12mo. Pp. 263. Illustrated. (London: Longmans, Green, and Co., 1896.)

FROM the first it was evident that the beautifully illustrated volumes of the "Fur and Feather Series" would appeal more to the sportsman and the *bon-vivant* than to the naturalist. That this is the case with the present issue may be inferred from the fact that out of a total of 263 pages, only a paltry sixty-two are devoted to what the author calls the natural history of the hare. As a matter of fact, it is impossible to apply the term "natural history" to the subject of more than the first forty-eight pages; the third chapter in Mr. Macpherson's

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section of the work being devoted to the legislation concerning the animal in question, while the fourth bears the mysterious title of "The Hare and her Trod." From reading the text, we infer that "trod" has something to do with poaching, although of its precise signification we are still in ignorance.

In the preface to the series the editor makes it to be understood that the natural history of the animals forming the subjects of the different volumes will be treated somewhat fully. We are, however, very doubtful whether the more or less discursive gossip communicated by Mr. Macpherson is entitled to be regarded as natural history at all. There exist, it may be remembered, as models for popular monographs of any particular animal, the little volume on "The Horse," by Sir W. H. Flower, and the more pretentious work of Prof. Mivart on "The Cat"; and the author would, we think, have done well to have followed somewhat on those lines. Instead of having done this, we are not even told that the hare is a rodent, much less do we learn anything about its relatives of the same genus, and the points in which these latter differ. Beyond a few observations as to its occurrence in the different counties of Britain, and certain variations in colour and size assumed by the animal in some European countries, we are left absolutely in the dark as to the geographical range of the common hare—a subject which well merits full consideration in a work of this nature. Throughout the first chapter we find no mention of either the generic or specific names of the hare; a matter which might be passed without comment, were it not that on page 12 both scientific names of an unimportant parasite are introduced without any possible advantage. When, however, we reach page 30, we find mention for the first time of the genus *Lepus* in connection with two American species; the reader—if not a naturalist—being left to find out for himself whether the common hare is or is not a member of the same genus. What might be the aforesaid uninstructed reader's view as to the zoological position of the rabbit, we dare not hazard a guess!

Such observations as are given on the natural history of the hare, appear to relate chiefly to its breeding habits, its marvellous speed, and the depredations it commits on farm and garden crops. Although doubtless accurate enough in this way, they are very far from forming anything like a complete history of the animal, and are too discursive for our own taste, even in a popular book. Nothing in the way of new facts appears to be given, although this may well be excused.

As may be inferred from what we have written, the whole of the natural history portion of the work is from the pen of Mr. Macpherson. Several authors—among whom may be named the Hon. G. Lascelles and Mr. C. Richardson—are, however, responsible for the sporting sections; while the chapter on cookery has been written by Colonel K. Herbert. Whatever may be its shortcomings from a zoological point of view, the work, so far as we can judge, from the sporting aspect is in every way admirable, and it ought specially to become an invaluable companion to the country gentleman. The numerous fine illustrations make the volume excellent from an artistic point of view.

R. L.

OUR BOOK SHELF.

Grundriss einer Geschichte der Naturwissenschaften. Von Dr. Friedrich Dannemann. I. Band. Erläuterte Abschnitte aus der Werken hervorragender Naturforscher. Pp. xii + 375. (Leipzig: Wilhelm Engelmann, 1896.)

THE idea upon which this book is constructed is an admirable one. By means of extracts and translations from the writings of great philosophers and investigators, a panorama of scientific history is presented in a most attractive form. Beginning with Aristotle and his Natural History, the author passes before the reader in historical succession the works and thoughts of Archimedes, Copernicus, Galileo, Gilbert, Kepler, Newton, Huyghens, Laplace, Lavoisier, Blumenbach, Cuvier, Darwin, and the host of other great thinkers and workers, who have helped to build up the edifice of scientific knowledge. To do this, Ostwald's excellent series of "Klassiker der exakten Wissenschaften" have been largely utilised. But we hasten to remark that the present volume does not merely consist of extracts and illustrations from series of reprints. A biographical note precedes the story in which each investigator tells of his work, and helpful editorialnotes are distributed throughout the book.

The work will be completed in two volumes, and we look forward with pleasure to the publication of the second one. The best text-book is the one which brings the student into close contact with the investigator, and thus creates in him a spirit of emulation. Dr. Dannemann's volume shows how this kindred feeling can be developed; therefore we welcome it as a valuable addition to scientific literature.

The Biological Problem of To-day. Preformation or Epigenesis? The Basis of a Theory of Organic Development. By Prof. Dr. Oscar Hertwig. Authorised translation by P. Chalmers Mitchell, M.A. Pp. xix + 148. (London: William Heinemann, 1896.)

THE German edition of Dr. Hertwig's discursive treatise —"Präformation oder Epigenese?"—was so fully reviewed in these columns shortly after it appeared (vol. li. p. 265, 1895), that it is unnecessary to state again the criticism contained in it of Weismann's theory of the germplasm and doctrine of determinants, or to go over Dr. Hertwig's own theory of the development of organisms. The fact that this translation is an authorised one, and that it bears the name of Mr. Chalmers Mitchell, is a sufficient guarantee for biologists that the arguments set forth in the original edition are faithfully reproduced. In a lucid introduction, Mr. Chalmers Mitchell states the positions taken by Weismann and Hertwig, and points to the issue involved. This statement, and the glossary of technical terms, will be very helpful to readers who have but a general idea of the matters on which the argument turns. The German words "Erbgleich" and "Erbungleich," which Mr. Bourne proposed to translate isocleronomic and anisocleronomic, have been rendered by the words "doubling" and "differentiating." The word "rudiment" has been used as the equivalent of "Anlage," and most biologists will agree that it well covers the meaning of the German word.

Every one interested in the problems of heredity will be grateful for this translation of a very important treatise.

The X-Rays. By Arthur Thornton, M.A. Pp. 63. 25 illustrations. (Bradford: Percy Lund and Co., Ltd. 1896.)

THIS slender brochure contains a general statement of the nature of sound, light, electrical vibrations, and electrical discharges through gases, together with brief instructions for observing and photographing Röntgen phenomena, and an explanation of the theories concerning the nature of Röntgen rays. For readers desirous of obtaining an idea of the prominent features of Röntgen's discovery, the book may be recommended.

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